بسم الله الرحمن الرحيم

IN THE NAME OF GOD

Nutritional Facts of Honey

Ahmed G. Hegazi[1], Faiz M. Al Guthami[2] and Ahmed F.M. Al Getham[2]

[1]National Research Centre, Dokki, Giza, Egypt and [2]Makkah Bee Association, Saudi Arabia

Evaluation of antibacterial activity of Saudi Arabia honeys

Special thanks to Scientific Committee of the

- **6th Apimedica & 5th Apiquality International Symposium**
- **Rome, Italy**

22-25 November
2016


المركز القومي للبحوث
NATIONAL RESEARCH CENTRE

National Research Centre

Nutritional Facts of Honey

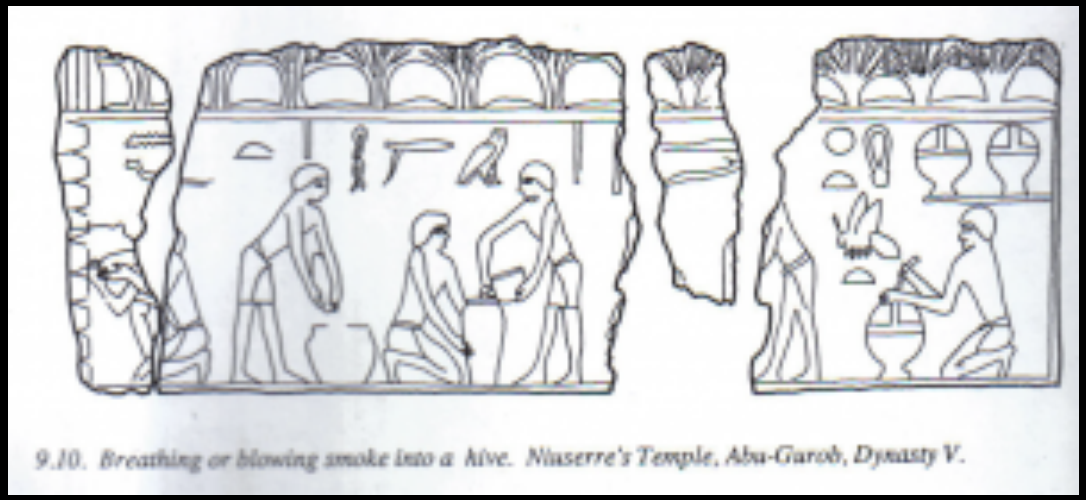
Honey

- Honey collection is an ancient activity.
- Humans apparently began hunting for honey at least 8,000 years ago.
- The bees were subdued with smoke and the tree or rocks opened resulting in destruction of the colony (Crane, 1983). .

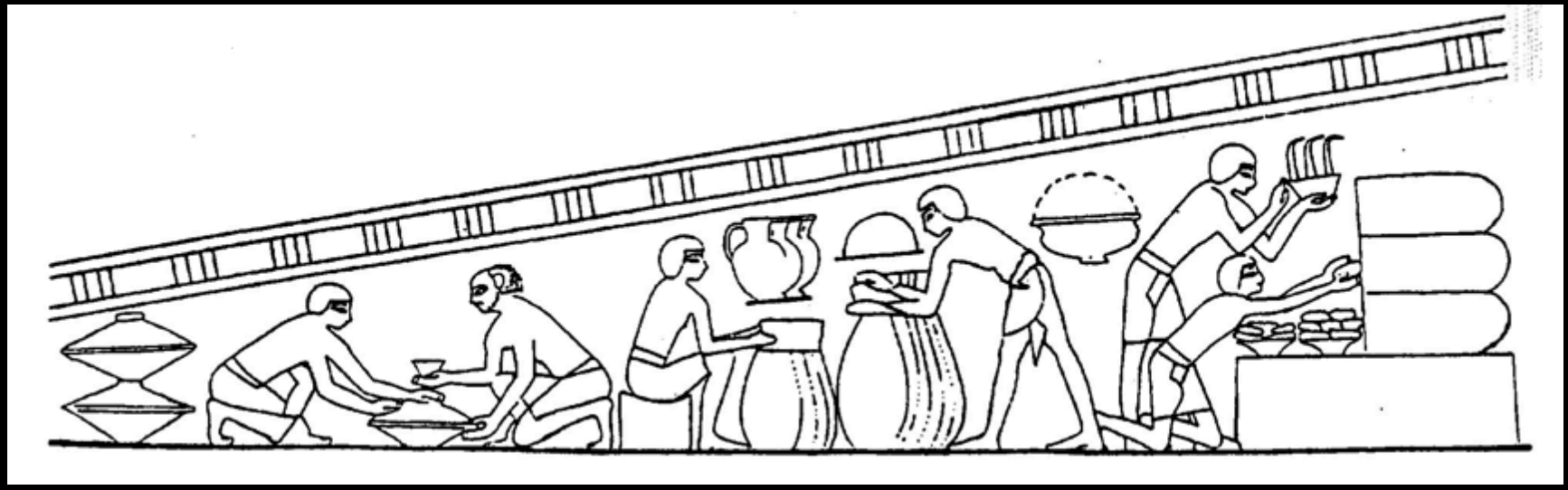
Historic Record

- Humans eventually began providing cavities for honey bees to nest in.
- Earliest records are Egyptian

Egyptian beekeeping



9.10. Breathing or blowing smoke into a hive. Niuserre's Temple, Abu-Gurob, Dynasty V.



Honey

- In ancient Egypt, honey was used to sweeten cakes and biscuits, and was used in many other dishes.
- Ancient Egyptian used honey for embalming the dead.
- The fertility god of Egypt, Min, was offered honey (Hegazi, 2012).

Definition

- Honey is a sweet food made by bees using nectar from flowers.
- The variety produced by honey bees (genus *Apis*)
- Honey bees transform nectar into honey by a process of regurgitation and evaporation.
- They store it inside the bee hive

(The National Honey Board, 2003).

Definition

- Honey to early man was a miracle, a substance that was intensely sweet
- immune from spoilage
- the level of sugar prevents microorganisms from existing.

Honey

- **Honey is one of the oldest medicines**.
- Its use is recorded in Egyptian papyri dated from 1900 to 1250 B.C.
- used many of the Egyptian prescriptions.
- He found that honey "cleans sores and ulcers of the lips, heals carbuncles and running sores

Religious significance

- In Old Testament law, offerings were made in the temple to God.
- Pure honey is considered Kosher even though it is produced by a flying insect, a non-kosher creature; other products of non-kosher animals are not kosher

(Chabad.org, 2010).

- In Christendom, there are references made to the importance of bees and honey in the Bible, and these include the Books of Exodus, Judges, Mathew and Proverbs [8-11].
- In accordance with this Christian holy book, the Bible, King Solomon was quoted thus: “Eat honey my son, because it is good” [11].

Religious significance

- In the Christian New Testament, Matthew 3:4, John the Baptist is said to have lived for a long period of time in the wilderness on a diet consisting of locusts and wild honey.
- In the Bible (Old Testament), King Solomon said, "My son, eat thou honey, for it is good", and there are a number of reasons why it may be good.

Religious significance

- In Islam, there is an entire Surah in The Holy Qur’an called an-Nahl (the Bee).
- According to Hadith, Prophet Muhammad strongly recommended honey for healing purposes (Sahih Bukhari).
- The Qur'an promotes honey as a nutritious and healthy food.
- “وَأَوْحَىٰ رَبُّكَ إِلَى ٱلنَّحْلِ أَنِ ٱتَّخِذِى مِنَ ٱلْجِبَالِ بُيُوتًا وَمِنَ ٱلشَّجَرِ وَمِمَّا يَعْرِشُونَ (٦٨) ثُمَّ كُلِى مِن كُلِّ ٱلثَّمَرَٰتِ فَٱسْلُكِى سُبُلَ رَبِّكِ ذُلُلًا ۚ يَخْرُجُ مِنۢ بُطُونِهَا شَرَابٌ مُّخْتَلِفٌ أَلْوَٰنُهُۥ فِيهِ شِفَآءٌ لِّلنَّاسِ ۗ إِنَّ فِى ذَٰلِكَ لَءَايَةً لِّقَوْمٍ يَتَفَكَّرُونَ” (٦٩)

سُورَةُ النَّحۡلِ

ترتيبها ١٦ — آياتها ١٢٨

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

وَأَوۡحَىٰ رَبُّكَ إِلَى ٱلنَّحۡلِ أَنِ ٱتَّخِذِي مِنَ ٱلۡجِبَالِ بُيُوتٗا وَمِنَ ٱلشَّجَرِ وَمِمَّا يَعۡرِشُونَ ٦٨ ثُمَّ كُلِي مِن كُلِّ ٱلثَّمَرَٰتِ فَٱسۡلُكِي سُبُلَ رَبِّكِ ذُلُلٗاۚ يَخۡرُجُ مِنۢ بُطُونِهَا شَرَابٞ مُّخۡتَلِفٌ أَلۡوَٰنُهُۥ فِيهِ شِفَآءٞ لِّلنَّاسِۗ إِنَّ فِي ذَٰلِكَ لَأٓيَةٗ لِّقَوۡمٖ يَتَفَكَّرُونَ ٦٩

Top Five Natural Honey Producing Countries

Rank	Country	2010	2011	2012
1	China	401,000	431,000	436,000
2	Turkey	81,115	94,245	88,162
3	Argentina	59,000	74,000	75,500
4	Ukraine	70,873	40,311	70,134
5	United States	80,042	67,294	66,720
—	*World*	1,222,601	1,169,441	1,260,229

Source: *UN Food & Agriculture Organization (FAOstat Browse data)*

Honey Facts

- There are over 25,000 species of bees worldwide.
- An adult worker bee's lifespan is about 45 days during summer months.
- A typical Bee colony consists of 30,000 to 60,000 bees.
- Male bees are called "Drones" and they do not have stingers, their only purpose is to mate with the queen bee.

- A queen bee can sting multiple times without dying.
- 99% of the bee colony is made up of female bees known as worker bees.
- The average honey bee's wings flap over 183 times per second.
- Bees have an excellent sense of smell which allows them to find their hive.

- Honey Bees actually dance when they return to the hive to tell the other bees where the flowers are.
- Honey is the ONLY food source produced by an insect that humans eat.
- Worker honey bees transform the floral nectar the gather into honey by adding enzymes to the nectar and reducing the moisture.

Nutritional Facts of Honey

Honey Nutrition

- Honey is much more than just a simple sugar. Rich in minerals and nutrients, honey also has some antibiotic properties that may aid in the healing process.
- For thousands of years honey has been used by mankind in many capacities to help give the human body energy and health.

Honey composition:

Component	Average (%)
Moisture	17.2
Fructose	38.19
Glucose	31.28
Sucrose	1.31
Disaccharides, calculated as maltose	7.31
Higher sugars	1.5
Free acid as gluconic	0.43
Lactone as Gluconolactone	0.14
Total acid as gluconic	0.57
Ash	0.169
Nitrogen	0.041

Data was collected from 490 samples of US honey (White et al., 1962).

Honey : Nutritional value per 100 g (3.5 oz)	
Energy	1,272 kJ (304 kcal)
Carbohydrates	82.4 g
Sugars	82.12 g
Dietary fiber	0.2 g
Fat	0 g
Protein	0.3 g

Vitamins

Honey : Nutritional value per 100 g (3.5 oz)

Vitamins	
Riboflavin (B2)	(3%) 0.038 mg
Niacin (B3)	(1%) 0.121 mg
Pantothenic acid (B5)	(1%) 0.068 mg
Vitamin B6	(2%)0.024 mg
Folate (B9)	(1%) 2 µg
Vitamin C	(1%) 0.5 mg

Honey : Nutritional value per 100 g (3.5 oz)

Calcium	(1%) 6 mg
Iron	(3%) 0.42 mg
Magnesium	(1%) 2 mg
Phosphorus	(1%) 4 mg
Potassium	(1%) 52 mg
Sodium	(0%) 4 mg
Zinc	(2%) 0.22 mg
Other constituents	
Water	17.10 g
Shown is for 100 g, roughly 5 tbsp.	Units: µg = micrograms • mg = milligrams IU = International units

Percentages are roughly approximated using US recommendations for adults.

Source: USDA Nutrient Database

Calorie Information

Amounts Per Selected Serving		%DV
Calories	1031 (4317 kJ)	52%
From Carbohydrate	1027 (4300 kJ)	
From Fat	0.0 (0.0 kJ)	
From Protein	3.4 (14.2 kJ)	
From Alcohol	0.0 (0.0 kJ)	

Protein & Amino Acids

- Amounts Per Selected Serving %DV
- Protein 1.0 g 2%

Tryptophan	**13.6 mg**
Threonine	13.6 mg
Isoleucine	27.1 mg
Leucine	33.9 mg
Lysine	27.1 mg

Protein & Amino Acids

Methionine	**3.4 mg**
Cystine	10.2 mg
Phenylalanine	37.3 mg
Tyrosine	27.1 mg
Valine	30.5 mg
Arginine	17.0 mg
Histidine	3.4 mg
Alanine	20.3 mg
Aspartic acid	91.5 mg
Glutamic acid	61.0 mg
Glycine	23.7 mg
Proline	305.0 mg
Serine	20.3 mg
Hydroxyproline	~

Carbohydrates

Amounts Per Selected Serving			%DV
Total Carbohydrate	279	g	93%

Dietary Fiber	**0.7**
Starch	~
Sugars	278 g
Sucrose	3017 mg
Glucose	**121174 mg**
Fructose	**138765 mg**
Lactose	~
Maltose	4882 mg
Galactose	10510 mg

Vitamins

Amounts Per Selected Serving		%DV
Vitamin A	0.0 IU	0%
Retinol	0.0 mcg	
Retinol Activity Equivalent	0.0 mcg	
Alpha Carotene	0.0 mcg	
Beta Carotene	0.0 mcg	
Beta Cryptoxanthin	0.0 mcg	
Lycopene	0.0 mcg	
Lutein+Zeaxanthin	0.0 mcg	
Vitamin C	1.7 mg	3%
Vitamin D	~	

Vitamins

Amounts Per Selected Serving		%DV
Vitamin E (Alpha Tocopherol)	0.0 mg	0%
Beta Tocopherol	~	
Gamma Tocopherol	~	
Delta Tocopherol	~	
Vitamin K	0.0 mcg	0%
Thiamin	0.0 mg	0%
Riboflavin	0.1 mg	8%
Niacin	0.4 mg	2%
Vitamin B6	0.1mg	4%
Folate	6.8 mcg	2%

Vitamins

Amounts Per Selected Serving		%DV
Food Folate	6.8 mcg	
Folic Acid	0.0 mcg	
Dietary Folate Equivalents	6.8 mcg	
Vitamin B12	0.0 mcg	
Pantothenic Acid	0.2 mg	2%
Choline	7.5 mg	
Betaine	5.8 mg	

Minerals

Amounts Per Selected Serving		%DV
Calcium	20.3 mg	2%
Iron	1.4 mg	8%
Magnesium	6.8 mg	2%
Phosphorus	13.6 mg	1%
Potassium	176 mg	5%
Sodium	13.6mg	1%
Zinc	0.7mg	5%
Copper	0.1mg	6%
Manganese	0.3 mg	14%
Selenium	2.7 mcg	4%
Fluoride	23.7 mcg	

Fats & Fatty Acids

Amounts Per Selected Serving		%DV
Total Fat	0.0 g	0%
Saturated Fat	0.0 g	0%
4:00	0.0 mg	
6:00	0.0 mg	
8:00	0.0 mg	
10:00	0.0 mg	
12:00	0.0 mg	
13:00	0.0 mg	
14:00	0.0 mg	

Fats & Fatty Acids

Amounts Per Selected Serving		%DV
15:00	0.0 mg	
16:00	0.0 mg	
17:00	0.0 mg	
18:00	0.0 mg	
19:00	0.0 mg	
20:00	0.0 mg	
22:00	0.0 mg	
24:00	0.0 mg	

Fats & Fatty Acids

Amounts Per Selected Serving		%DV
Monounsaturated Fat	0.0 g	
14:01	0.0 mg	
15:01	0.0 mg	
16:1 undifferentiated	0.0 mg	
16:1 c	0.0 mg	
16:1 t	0.0 mg	
17:01	0.0 mg	

Fats & Fatty Acids

Amounts Per Selected Serving		%DV
18:1 undifferentiated	0.0 mg	
18:1 c	0.0 mg	
18:1 t	0.0 mg	
20:01	0.0 mg	
22:1 undifferentiated	0.0 -mg	
22:1 c	0.0 mg	
22:1 t	0.0 mg	
24:1 c	0.0 mg	

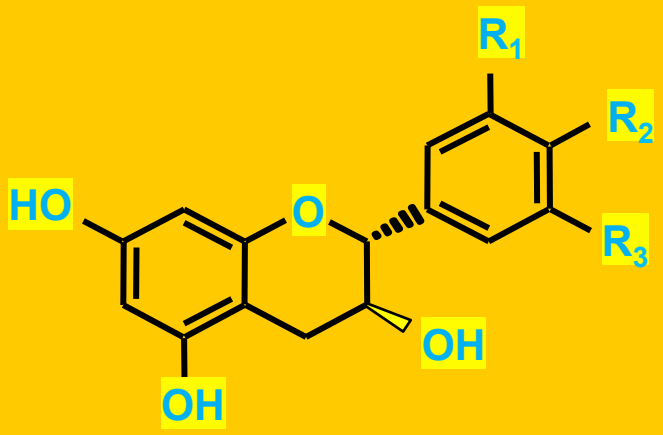
Sterols

Amounts Per Selected Serving		%DV
Cholesterol	0.0 mg	0%
Phytosterols	~	
Campesterol	~	
Stigmasterol	~	
Beta-sitosterol	~	

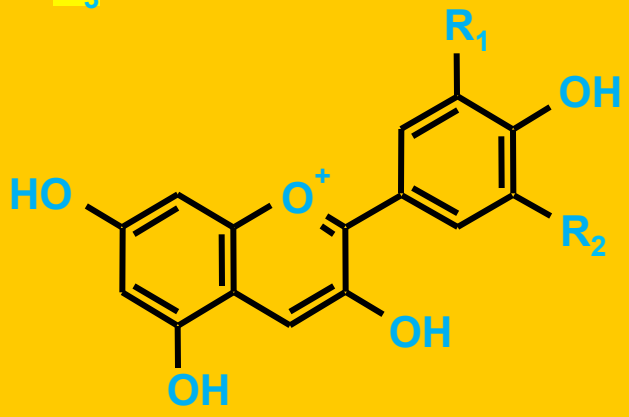
Other

Amounts Per Selected Serving		%DV
Alcohol	0.0 g	
Water	58.0 g	
Ash	0.7 g	
Caffeine	0.0 mg	
Theobromine	0.0 mg	

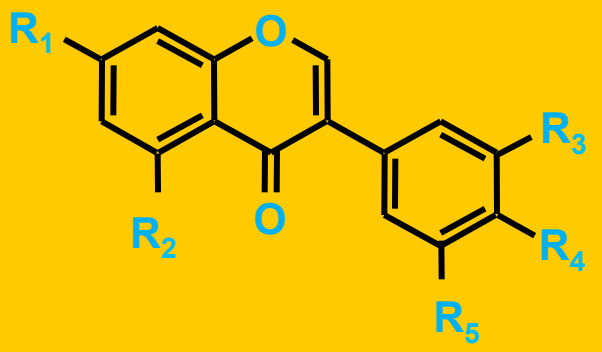
Flavonoids: structure



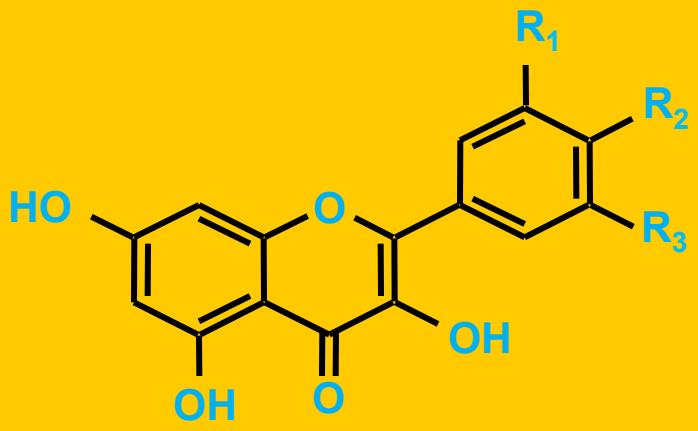
Flavanol



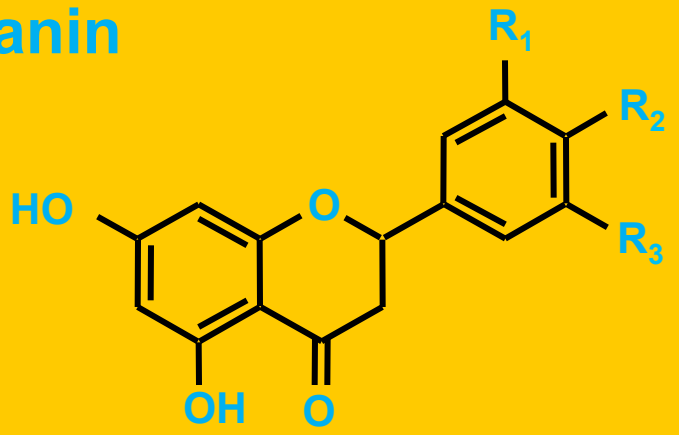
Anthocyanin



Isoflavone



Flavonol



Flavanone

Subclasses and Dietary Sources of Flavonoids :(Wang HK, 2000)

Flavonoid subgroup	Representative flavonoids
Flavonols	Kaempherol, myricetin, Quercetin, rutin
Flavones	Apigenin, chrysin, luteolin
Isoflavones	Daidzein, genistein, glycitein, Formononetin.
Flavanols	Catechin, gallocatechin
Flavanones	Eriodictyol, hesperitin, Naringenin.
Flavanonols	Taxifolin

Chemical composition assessed by GC/MS of ether extracts of Honey Samples. Hegazi et al., 2007

Compound	Acacia	Coriander	Sider	Palm
	% TIC [a]			
Aliphatic Acids				
Hydroxyacetic acid	--	0.03	0.06	0.17
2-Hydroxypropanoic acid	18.70	0.21	0.04	0.56
3-Hydroxypropanoic acid	0.40	0.07	0.01	0.13
2-Methyl-3-hydroxypropanoic acid	0.01			
2,3-Dihydroxypropanoic acid	0.32	0.04	2.04	0.82
2-Oxo-3-hydroxypropanoic acid	---	---	0.04	---
Lactic acid dimmer	---	---	---	0.05
2-Methyl-2-hydroxybutanoic acid	0.05	---	---	---
3-Methyl-3-hydroxybutanoic acid	0.04	---	---	---
5-Hydroxy-n-valeric acid	8.27	3.62	0.21	---
4-Oxo-pentanoic acid	0.11	---	---	---
Pentanoic acid-2-deoxy-3,5-dihydroxy	---	0.30	---	---
Pentanoic acid-5-deoxy-2,3-dihydroxy-ã-lactone	---	0.05	---	---
Pentanoic acid-5-deoxy-2,3-dihydroxy-ã-lactone (isomer)	---	0.30	---	---
2,3,4,5-Tetrahydroxypentanoic acid-1,4-lactone	---	---	2.07	---
2,3,4,5-Tetrahydroxypentanoic acid-1,4-lactone(isomer)	--	---	0.09	---
Succinic acid ***	---	---	---	28.72
Malic acid (hydroxyl-succinic acid)***	0.30			1.16
2-butenedioic acid (E) ***	0.07	---	---	1.25
Methyl butandioic acid***	0.14	0.02	0.01	0.30
2-Hexenoic acid	10.50	---	0.08	---
Pentanedioic acid ***	---	0.01	---	0.37
7-Methyl- pentanedioic acid ***	---	---	---	0.12
3-Hydroxy caproic acid	---	0.30	0.15	---
7-Hydroxy-octanoic acid	---	---	0.03	0.20
Octandioic acid ***	0.66	0.04	0.13	---
2,3,5-Trihydroxyxylonic acid-ã-lactone	---	0.04	---	---
Nonandioic acid(azelic acid)***	0.94	0.09	0.35	---
Decandioic acid(sebacic acid) ***	3.29	---	0.68	5.74
3-Hydroxy-sebacic acid ***	0.51	---	---	---
Tetradecanoic acid	0.17	0.06	0.20	---
Pentadecanoic acid	---	----	0.19	---
Palmitic acid	4.75	0.9	3.39	1.50
Oleic acid	5.41	1.53	3.34	---
Stearic acid	---	0.79	1.04	---
Ecosanoic acid	0.09	0.18	---	0.14
Docosanoic acid	---	0.14	---	---
Total Aliphatic Acids	54.73	8.72	22.87	64.10

Chemical composition assessed by GC/MS of ether extracts of Honey Samples. Hegazi et al., 2007

Compound	Acacia	Coriander	Sider	Palm
	% TIC [a]			
Aromatic acids				
Benzoic acid	0.07	-	-	-
2-Aminobenzoic acid [b]	-	-	0.03	-
3,4-Dimethoxybenzoic acid	---	0.11	---	---
4-Hydroxy benzoic acid	0.32	0.57	1.67	4.15
Vanillic acid	0.36	0.14	0.27	3.05
3,4-Dihydroxybenzoic acid	---	0.04	0.07	---
3,4-Dimethoxybenzene acetic acid	-	0.02	-	-
á- Hydroxybenzene propanoic acid	0.05	-	-	0.30
2-Furancarboxylic acid	0.12	0.02	-	-
2-Furancarboxylic acid-5-hydroxymethyl	1.14	0.07	-	0.44
Furyl acrylic acid [b]	-	-	0.03	-
Cinnamic acid	0.09	-	-	-
p-Hydroxydihydro-cinnamic acid	-	-	0.56	-
3,4- Dimethoxy-cinnamic acid	-	-	-	3.00
2,5- Dimethoxy-cinnamic acid	-	-	-	0.17
Cis- p-Coumaric acid	0.15	0.05	0.07	0.21
Caffeic acid	-	-	-	0.36

Chemical composition assessed by GC/MS of ether extracts of Honey Samples. Hegazi et al., 2007

Compound	Acacia	Coriander	Sider	Palm
	% TIC a			
Esters				
Monoethylsuccinate	-	0.05	-	-
Ethyl palmitate	-	0.18	-	-
Methyloleate	0.37	-	-	-
Ethyloleate	-	0.7	0.13	-
Ethylstearate	-	0.03	-	-
12-hydroxy stearic acid methyl ester	-	0.08	-	-
Palmitic acid decyl ester	-	0.22	-	-
Oleic acid octyl ester	-	0.38	-	-
Docosanoic acid ethyl ester	-	0.08	0.04	-
Tetracosanoic acid ethyl ester	-	0.15	-	-
Diterpenes				
Dehydroabietic acid	0.8	0.08	0.04	-

Chemical composition assessed by GC/MS of ether extracts of Honey Samples. Hegazi et al., 2007

Compound	Acacia	Coriander	Sider	Palm
	% TIC [a]			
Others				
1-Methyl pentanol	-	-	-	0.06
2,3-Butane diol	0.52	-	-	-
2,3-Butane diol(isomer)	0.8	-	-	-
3-Methyl-1,3-dihydroxy butane	0.01	-	-	-
Glycerol	-	-	-	0.8
Phosphoric acid	-	0.05	0.02	0.04
3-Hydroxypyridine [b]	-	-	-	0.03
Picolinic acid(pyridine carboxylic acid) [b]	-	-	-	0.03
1,2- cyclohexane dicaboxylic acid	-	0.09	-	0.89
1,4-Dihydroxy benzene	-	0.07	-	1.06
2,3-Dimethoxy benzaldehyde	-	0.02	-	-
4-Hydroxy phenyl ethanol	-	0.02	-	0.11
Vanillyl alcohol	-	0.04	-	-
1,2-Benzenediol-3,5-bis(1,1-dimethylethyl)	-	-	0.20	-
2,4-bis(dimethyl benzyl)-6-t- butyl phenol	0.52	-	-	-
2(3H)-Furanne-dihydro-3,4-dihydroxy-(trans)	-	0.08	-	0.55
4H-pyran-4-one-5-hydroxy-2-hydroxymethyl	-	0.04	-	0.39
4H-pyran-4-one-5-hydroxy-2-hydroxymethyl (isomer)	-	-	-	1.11
Octadecanyl glycerol ether	0.06	1.4	-	-
Eicosanyl glycerol ether	0.14	1.6	-	-
Dihydroxy-methyl anthraquinones [b]	0.06	-	-	0.05
Dihydroxy-trimethyl anthraquinones [b]	0.26	0.3	-	-
Dihydroxy-trimethyl anthraquinones [b]	0.53	0.2	-	0.58
Dihydroxy-pentamethyl anthraquinones [b]	0.26	0.17	-	0.08

Medical Importance of *Honey*

- gives the best energy to the whole body
- Cleanses the digestive tract
- Stimulates the immune system
- Cures skin wounds
- Relaxes over-contracted muscles.

Medical Importance of *Honey*

- Honey help to replace lost electrolytes and provide an energy source
- honey used for many different purposes:
- as a laxative,
- as a cure for diarrhea
- upset stomach,

Medical Importance of *Honey*

- for coughs and throat maladies,
- to agglutinate wounds
- for eye diseases.
- Anti oxidant
- Anti-inflammatory
- Bio- stimulant
- Anticancer

Medical Importance of *Honey*

- It helps the detoxication body's mechanisms
- Treatment of respiratory affections
- Cardiovascular system
- Regenerative for connective tissues
- treat dyspepsia and stomach ulcers
- treatment of skin infection
- gastro-intestinal infections

Medical Importance *of Honey*

- Dermatology
- Ophthalmology
- Surgery
- In Pdiatric
  - Anamea
  - Desentry
  - Relaxation

Medical Importance of *Honey*

- Treatment of Burn Wounds and Skin Ulcers
- Treatment of Infant Gastroenteritis and Stomach Ulcers
- Anticancer and Antimycotic Infective Agents
- Liver diseases
- Nervous system
- Emollient
- **Energiser**

Medical Importance of *Honey*

- Immunostimulative
- Antimicrobial activity
- Anti fungal
- Antiviral

Antibacterial activity

- Honey inhibits the growth of micro-organisms and fungi.
- Honey was used to treat infection as long ago as 2000 years before bacteria were discovered to be the cause of infection.
- The antibacterial effect of honey, mostly against gram-positive bacteria, is well documented **(Molan, 1992, Bogdanov, 1997, Hegazi, 2011, Hegazi et al., 2002, 2012 and 2014a).**

Evaluation of antibacterial activity of honey:

- Both bacteriostatic and bactericidal effects have been reported for many strains,

- Honey has been reported to have an inhibitory effect to around 60 species of bacteria including aerobes and anaerobes, gram-positives and gram- negatives

(Molan, 1992).

Antibacterial activity

- Honey has been well studied for its antimicrobial and wound healing properties
- **Low water activity**
  - ~80% sugars
- **Low pH**
  - Gluconic acid
  - pH 3.2 – 4.5
- **Hydrogen peroxide**
  - Glucose oxidase

Antimicrobial activity against E. coli


المركز القومى للبحوث
١٩٥٦
١٣٧٥
NATIONAL RESEARCH CENTRE

Nutritional Facts of Honey

Nutritional Facts of Honey

Thank you

• Prof. Dr. Ahmed Hegazi

Professor of Microbiology and Immunology
National Research Center, Dokki, Giza, Egypt

President of Egyptian Environmental Society for uses and production of bee products
Secretary of Egyptian Society of Apitherapy
Secretary General of African Federation of Apiculture Associations
Member of Apitherapy Commission , APIMONDIA

E mail: ahmed@ahmedhegazi.com

and ahmedhegazi128@gmail.com

www.ahmedhegazi.com

Tel H: + 202 37749222
Fax H: + 202 37749222
Fax W: + 202 33370931
GMS: + 201 001440063